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Sustainable development: promotion of new and renewable sources of energy

Promotion of new and renewable sources of energy

Report of the Secretary-General

Summary

A transformation of the global energy system is needed to secure sustainable energy for all, to satisfy rapid growth in energy demand, particularly in developing countries, and to diminish the negative impacts of climate change. New and renewable sources of energy are at the centre of global efforts to induce a paradigm shift towards green economies, poverty eradication and, ultimately, sustainable development. Record investments are being made by some countries to propel the innovation, development and commercialization of renewable energy technologies. Nevertheless, much more cooperation and action are needed to substantially increase the contribution of these technologies to the global energy system. A coordinated global energy strategy needs to be adopted, in conjunction with consistent and stable national policies, to bring down the cost of renewable energy technologies, including off-grid systems, for use by the poorest segments of the population living in rural areas.

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I. Introduction

A. Mandates and resolutions

1. The Plan of Implementation of the World Summit on Sustainable Development[1] (Johannesburg Plan of Implementation) calls for action at all levels, with a sense of urgency, to substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply.[2] In resolution 64/206 on the promotion of new and renewable sources of energy, the General Assembly reaffirmed the need for the full implementation of the Johannesburg Plan of Implementation as the intergovernmental framework for energy for sustainable development and encouraged the United Nations system to continue to raise awareness of the importance of energy for sustainable development, including the need for the promotion of new and renewable sources of energy and of the increased role they can play in the global energy supply, particularly in the context of sustainable development and poverty eradication.

2. By the same resolution, the General Assembly, recalling the outcome of the 2005 World Summit,[3] welcoming initiatives that aim to improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services for sustainable development in order to contribute to the achievement of internationally agreed development goals, including the Millennium Development Goals, and recognizing the contributions of new and renewable sources of energy to the reduction of greenhouse gases and addressing climate change, called on the international community to the support the least developed countries, the landlocked developing countries and the small island developing States in their efforts to develop and utilize energy resources, including new and renewable energy.

3. Further, the General Assembly requested the Secretary-General to submit to it at its sixty-sixth session a report on the implementation of the resolution, taking into account, inter alia, the initiatives taken by Member States and international organizations to create an enabling environment at all levels for the promotion and use of new and renewable energy, including measures to improve access to such technologies. The present report is submitted pursuant to that request.

4. Subsequently, the General Assembly, in resolution 65/151, decided to declare 2012 the International Year of Sustainable Energy for All. It requested the Secretary-General to organize and coordinate activities to be undertaken during the Year and encouraged all Member States, the United Nations system and all other actors to take advantage of the Year to increase awareness of the importance of addressing energy issues. Initiatives to create an enabling environment for the promotion of access to energy and energy services and the use of new and renewable energy technologies are being undertaken by Member States and international organizations also in the context of the Year.

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[1] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex.

[2] Ibid., para. 20 (e).

[3] See General Assembly resolution 60/1.

B. Sustainable energy for all

5. The availability of adequate, affordable and reliable energy services is essential for alleviating poverty, improving human welfare, raising living standards and, ultimately, for achieving sustainable development. As global development challenges continue to be addressed, it is increasingly recognized that the provision of adequate energy services has a multiplier effect on health, education, transport, telecommunications, and water availability and sanitation. Consequently, energy is an important factor for the achievement of the Millennium Development Goals.

6. Securing sustainable energy for all involves the development of systems that support the optimal use of energy resources in an equitable and socially supportive manner while minimizing their environmental impact. Integrated national and regional infrastructure for energy supply, efficient transmission and distribution systems, as well as demand programmes that emphasize energy efficiency, are necessary for the development of sustainable energy systems.

7. Universal energy access is essentially related to access to modern energy fuels which can replace traditional biomass consumption for cooking, heating and lighting. It is also related to access to electricity. Traditional biomass is solid biomass used in an unsustainable manner and includes fuelwood, agricultural waste and animal dung. It usually represents the only fuel available or affordable to the poor in many developing regions. Worldwide, about 2.7 billion people depend on traditional biomass for cooking, 82 per cent of whom live in rural areas.[4] Modern or commercial biomass is produced in a sustainable way and can be used for electricity generation, heat production and transportation.

8. The use of solid fuels and the lack of ventilation in households in developing countries are associated with very high levels of pollutants, such as particulates, carbon monoxide and formaldehyde. Women and young children represent the segments of the population with the highest exposure to these pollutants.[5] Therefore, lack or insufficient use of commercial energy has been found to be correlated with high infant mortality, illiteracy and low life expectancy. It is estimated that about 1.45 million premature deaths occur each year from household indoor pollution due to inefficient biomass combustion. This corresponds to more than 4,000 deaths per day. Many of these premature deaths are young children and women.

9. Electricity has many uses and is irreplaceable for a number of applications. Of the 1.4 billion people throughout the world who live without electricity, 85 per cent live in rural areas. Sub-Saharan Africa has the largest number of people (about 585 million) who have no access to electricity. Over 400 million people in India, mostly living in rural areas, also lack access. Electricity access in rural areas is restricted by the need for capital to extend the national electric grids and by the lack of available and affordable modern fuels which could be used for electricity generation.

10. World challenges, including impacts from climate change, limited natural resources, rapid increase in energy demand and loss of biodiversity, demand a

[4] International Energy Agency (IEA), World Energy Outlook 2010 (Paris, 2010).

[5] United Nations Development Programme (UNDP) and World Health Organization (WHO), *The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa* (New York and Geneva, November 2009).

greater reliance on new and renewable sources of energy. Accessibility and affordability of renewable energy technologies are key to ensuring sustainable energy for all.

C. Global energy systems

11. Global primary energy demand has continued to grow in the past several years and amounted to 12,271 million tons of oil equivalent in 2008. The world still relies largely on oil, coal and gas (see table 1). In 2008, over 80 per cent of the primary energy consumed was derived from fossil fuels, with oil and coal accounting for about 60 per cent.

Table 1
World primary energy demand by fuel
(Millions of tons of oil equivalent)

Fuel	*1980*	*1990*	*2000*	*2008*
Coal	1 792	2 233	2 292	3 315
Oil	3 107	3 222	3 655	4 059
Gas	1 234	1 674	2 085	2 596
Nuclear	186	526	676	712
Hydropower	148	184	225	276
Biomass	749	904	1 031	1 225
Other renewable	12	36	55	89
Total	**7 228**	**8 779**	**10 019**	**12 271**

Source: IEA, World Energy Outlook 2009 (Paris, 2009) and World Energy Outlook 2010 (Paris, 2010).

12. Major increases in world energy demand are expected to continue in the forthcoming decades, especially in developing countries. The demand for energy will accelerate as a result of rapid economic growth in emerging economies and increases in the world's population, which is projected to rise from 6.7 billion in 2008 to 8.5 billion by 2035. According to the International Energy Agency (IEA),[6] global primary energy demand will grow to values ranging between 14,900 and 18,000 million tons of oil equivalent, depending on the scenario being considered. In the IEA new policies scenario, which takes into account the broad policy commitments and plans announced by many countries around the world, global primary energy demand will grow by 36 per cent by 2035, with countries non-members of the Organization for Economic Cooperation and Development (OECD) accounting for 93 per cent of the increase. Fossil fuels will maintain their central role in primary energy but their share will decline to 74 per cent in 2035. China will account for 35 per cent of the global increase and India for 18 per cent.

[6] *World Energy Outlook 2010*.

II. Overview of new and renewable sources of energy

A. Status

13. The role of renewable energy in global energy supply continues to increase in some regions of the world. The trends of the past decade and, in particular, the past five years reflect strong growth in all energy sectors, including power generation, heating and cooling, and transport fuels. Nevertheless, the overall contribution of new and renewable sources of energy to the global energy system remains very limited.

14. Recent global events, such as the oil spill in the Gulf of Mexico in 2010 and the impact of natural disasters on the Fukushima nuclear plant in Japan in 2011, highlight the importance of continuing to develop cost-competitive new and renewable sources of energy. In many countries, policymakers and the public and private sectors are becoming more supportive of global and national strategies to accelerate the deployment of renewable energy technologies and to expand their corresponding markets. These efforts are key to sustaining the transformation of the energy systems and to fuelling the green economies of the future.

15. In order to assess the role of renewable energy in meeting global energy demand, it is necessary to look at its share in primary energy, final energy, electricity generation and electricity generating capacity. Table 2 shows the global share of renewable energy in each of these four energy categories.

Table 2
Share of renewable energy in four energy categories
(Percentage)

Renewable energy	*Share in primary energy*	*Share in final energy consumption*	*Share in electricity generation*	*Share in electricity generating capacity*
Total	**13**	**16**	**19**	**27**
Excluding traditional biomass	7	6	19	27
Excluding traditional biomass and considering only small hydropower (less than 50 megawatts)	4.9	3.0	4.6	8.0

Source: Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2011: Global Status Report* (Paris, REN21 Secretariat, 2011); and IEA, *World Energy Outlook 2010* (Paris, 2010).
Note: Data for total primary energy and final energy consumption are for 2009. Data for electricity generation and electricity generating capacity are for 2010.

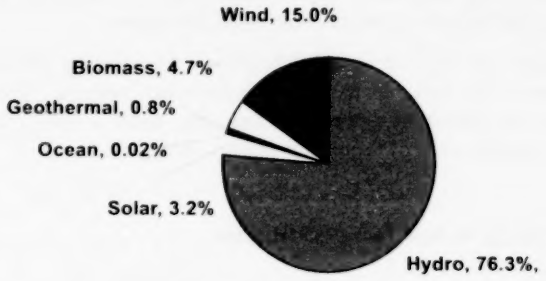
16. Table 2 contains three sets of values for the four energy types. The first line shows total shares of renewable energy, including traditional biomass. If traditional biomass is excluded (second line), the share in primary energy and final energy consumption decreases to 7 per cent and 6 per cent, respectively. The third line shows shares of renewable energy without traditional biomass and only if small hydropower is considered. In this case, the share of renewable energy in electricity generation is reduced to 4.6 per cent and in electricity generating capacity to 8.0 per cent.

17. All types of hydropower are renewable, but references to new renewable energy usually include only small hydropower plants with capacities of less than

50 megawatts.[7] Small hydropower is considered critical for many developing countries and is usually reported and tracked separately in policy and market contexts. Many financiers and development assistance agencies consider only small hydropower as eligible for renewable portfolio standards, feed-in-tariffs and tax credits. Also, many countries define renewable targets based on small hydropower in order to focus on the dynamic growth and features of markets for wind, solar, bioenergy, geothermal and other new renewable energy sources.[8]

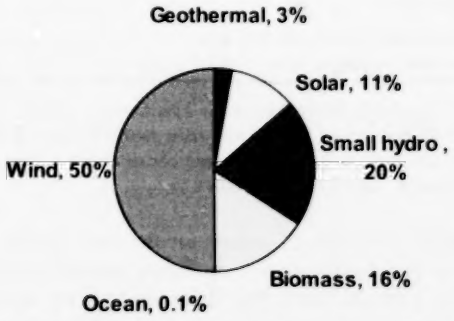
18. Figure 1 shows the share of various renewable energy sources in global renewable electric power capacity. Total hydropower has by far the largest share, followed by wind, with the other renewable sources accounting for less than 9 per cent. When only small hydro is considered, the share of wind is 50 per cent, followed by small hydro, biomass and solar (see fig. 2).

Figure 1
Share of global renewable electricity power capacity, 2010



Source: REN21, *Renewables 2011: Global Status Report* (Paris, REN21 Secretariat, 2011).

Figure 2
Share of global renewable electric power capacity (considering small hydro only), 2010



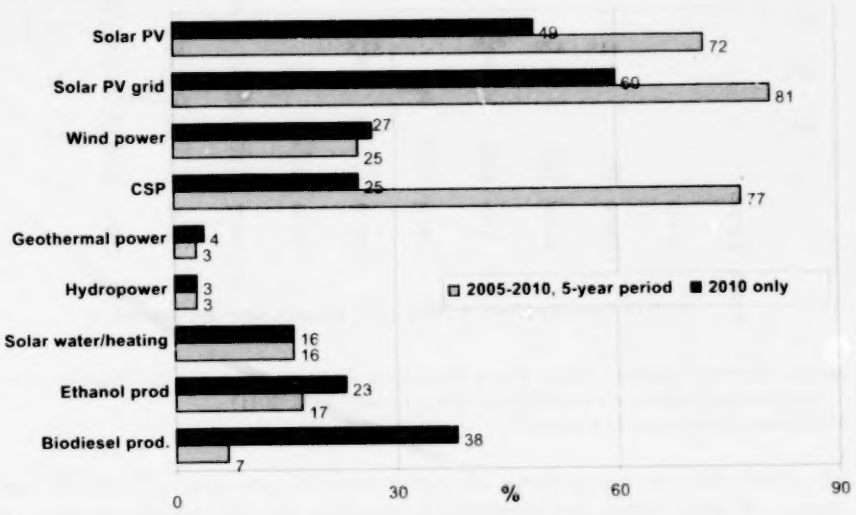
Source: The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G20 Investment Powering Forward* (Philadelphia, Pennsylvania, 2011).

[7] Some references consider small hydropower plants to be those with a capacity of less than 10 megawatts.

[8] Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2011: Global Status Report* (Paris, REN21 Secretariat, 2011).

19. The growth of renewable energy capacity and biofuel production in the period from 2005 to 2010 is illustrated in figure 3. Most new and renewable sources of energy grew at an accelerated pace. Solar capacity experienced the fastest growth, with solar photovoltaic connected to the grid increasing by 81 per cent and concentrated solar power by 77 per cent.

Figure 3
Average annual growth rate of renewable energy capacity and biofuel production, 2005-2010 and 2010

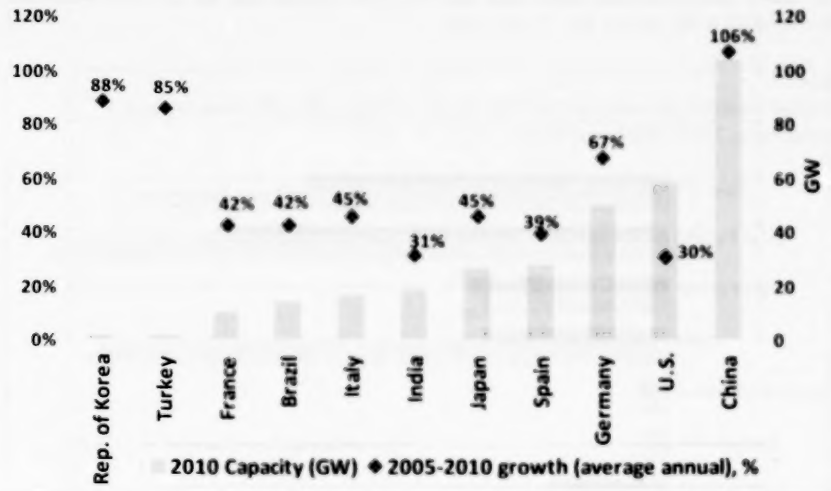


Source: REN21, *Renewables 2011: Global Status Report* (Paris, REN21 Secretariat, 2011).
Abbreviations: CSP, concentrated solar power; PV, photovoltaic.

20. China is leading the world in installed new renewable energy capacity, followed by the United States of America (see fig. 4).[9] Other developing countries with a relatively large capacity include Brazil, India and Turkey. China has also been leading in terms of growth in the past five years, followed by the Republic of Korea and Turkey. The industry is being supported in these countries by accelerated private investment, consistent and stable government energy policies and advances in technologies that are being translated into cost reductions.

[9] The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G20 Investment Powering Forward* (Philadelphia, Pennsylvania, 2011).

Figure 4
Countries with largest installed new renewable energy capacity, 2010, and capacity growth, 2005-2010



Source: The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G20 Investment Powering Forward* (Philadelphia, Pennsylvania, 2011).
Note: Data exclude large hydropower.

21. Cost estimate comparisons of energy technologies vary considerably and depend on many factors and assumptions that affect the calculations. In 2011, the Renewable Energy Policy Network for the 21st Century (REN21) published costs for renewable energy technologies from a variety of sources, including IEA, the National Renewable Energy Laboratory of the United States and the World Bank (see table 3). These costs are economic costs, exclusive of subsidies or policy incentives.

22. The costs of some renewable energy technologies are now competitive with the costs of conventional energy technologies, generally estimated to be between 4 and 10 cents per kilowatt hour.[10] Onshore wind, biomass and geothermal for power generation are becoming competitive in some world regions. Biomass, some solar and geothermal are also competitive in regard to hot water and heating, as is ethanol for transportation. Most alternatives for off-grid applications in rural areas are still too expensive. The high costs of these technologies, in addition to other important development and transfer barriers, indicate the need for more support to promote renewable energy in rural areas.

23. Nevertheless, technology improvements and innovation are allowing a rapid downward trend in the costs of most renewable energy technologies. Prices per megawatt for solar photovoltaic modules have fallen by 60 per cent since 2008. In

[10] REN21, *Renewable Energy Potentials in Large Economies — Summary Report: Opportunities for the Rapid Deployment of Renewable Energy in Large Economies, its Impacts on Sustainable Development and Appropriate Policies to Achieve It* (Paris, 2008); and Intergovernmental Panel on Climate Change, "Special report on renewable energy sources and climate change mitigation", New York, 2011 (available from http://srren.ipcc-wg3.de/).

some countries, solar has been reported to be competitive with other options in electricity retail prices. Wind turbine prices are also down 18 per cent since 2008.[11] The expectation is that this trend will continue.

Table 3
Cost of renewable energy technologies

Technologies	*Typical characteristics*	*Typical energy cost (US cents)*	*Comments*
Power generation (cost per kWh)			
Large hydro	10-18,000 (MW)	3-5	Currently one of the lowest-cost energy technologies
Small hydro	1-10 MW	5-12	
Onshore wind	1.5-3.5 MW	5-9	Blade diameter: 60-100 metres
Offshore wind	1.5-5 MW	10-20	Blade diameter: 70-125 metres
Biomass	1-20 MW	5-12	
Geothermal	1-100 MW	4-7	Types: binary, single-flash, double-flash, natural steam
Rooftop solar photovoltaic	2-5 kW-peak capacity	17-34	
	200 kW to 100 MW	15-30	
Concentrated solar power	50-500 MW (trough)	14-18	Costs for trough plants; costs decrease as plant size increases; a rapidly maturing technology
	10 20 MW (tower)		
Hot water/heating (cost per kWh)			
Biomass heat	1-20 MW	1-6	Most cost-competitive renewable energy technology for heating
Solar	2-5m² (household)	2-20	Household, medium and large
	20-200m² (medium/ multi-family)	1-15	Types: evacuated tube, flat-plate
	0.5-2 MWth (large/ district heating)	1-8	

[11] United Nations Environment Programme (UNEP) and Bloomberg New Energy Finance (BNEF), *Global Trends in Renewable Energy Investment 2011* (Paris, 2011).

Technology	*Typical characteristics*	*Typical energy cost (US cents)*	*Comments*
Geothermal	1-10 MW	0.5-2	Applied for heating and cooling
			Types: heat pumps, direct use, chillers
Biofuels (cost per litre)			
Ethanol	Sugar cane, sugar beet, corn, cassava, wheat	30-50 (sugar)	Gasoline equivalent
	Sorghum (and cellulose in future)	60-80 (corn)	Gasoline equivalent
Biodiesel	Soy, rapeseed, mustard seed, jatropha, palm, waste vegetable oils	40-80	Diesel equivalent
Rural (off-grid) energy (cost per kW)			
Minihydro	100-1,000 kW	5-12	
Microhydro	1-100 kW	7-30	
Picohydro	0.1-1 kW	20-40	
Biogas gasifier	20-5,000 kW	8-12	
Household wind turbine	0.1-3 kW	15-35	
Village-scale mini-grid	10-1,000 kW	25-100	
Solar home system	20-100 watts	40-60	

Source: REN21, *Renewables 2011: Global Status Report* (Paris, REN21 Secretariat, 2011).
Abbreviations: kW, kilowatt; kWh, kilowatt hour; MW, megawatt; MWth, megawatt thermal.

24. Technological innovations are anticipated in concentrated solar power and photovoltaic technologies and related manufacturing processes, enhanced geothermal systems, multiple emerging ocean technologies, advanced biofuels and biorefining, and foundation and turbine designs for offshore wind energy.[12]

25. The use of renewable energy also affords additional benefits which support the universal and national goals for sustainable development. One of the social areas in which renewable energy can provide added value is employment. Although some of the studies available differ on the magnitude of net employment generated, investment in renewable energy has been shown to create two to three times more jobs than investment in conventional energy. Globally, it is estimated that there are

[12] Intergovernmental Panel on Climate Change, "Special report on renewable energy sources and climate change mitigation", New York, 2011 (available from http://srren.ipcc-wg3.de/).

about 3.5 million direct jobs in renewable energy industries. In 2009 and 2010, about 1 million jobs were created by the renewable energy industry.[13]

26. Another important area of extreme importance for sustainable development is water. Renewable energy technologies using dry cooling are not as vulnerable as conventional water-cooled thermal power plants (including nuclear plants) to water scarcity and climate change. The management of water resources represents a very important issue in sustainable development.

B. Prospects

Investments

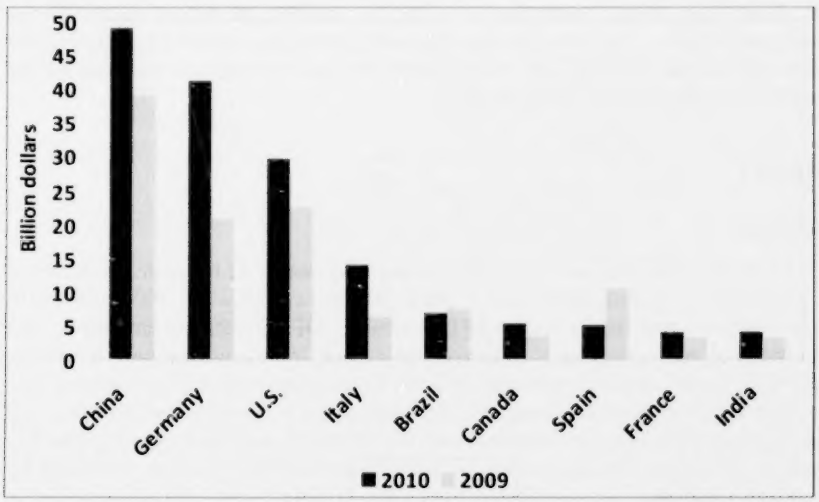
27. The market for new and renewable sources of energy is becoming a dynamic one. Financing of global clean energy grew 30 per cent between 2009 and 2010, with investments totalling a record $211 billion.[14] OECD member countries, and large emerging economies such as Brazil, China and India and, are now becoming leaders with stable long-term national policies which attract record investments. The investment by China in clean energy in 2010 represents a record at $48.9 billion and is the highest, followed by Germany and the United States (see fig. 5). The top investment in 2010 continued to be for wind power at $94.7 billion, followed by solar at $26.1 billion.

28. Countries are following different strategies in their investments. The United States has the highest investment in venture capital, which is for the early stage of the technology development cycle with the objective of capitalizing at a later stage. Europe has concentrated on stimulus for demand using regulatory policies, such as feed-in-tariffs, to meet targets which promote renewable electricity generation. Asia is trying to capture the supply chain of technologies, such as photovoltaic modules and wind turbines

[13] *Renewables 2011: Global Status Report*; and World Bank, "Design and performance of policy instruments to promote the development of renewable energy: emerging experience in selected developing countries", Energy and Mining Sector Board Discussion Paper No. 22 (Washington, D.C., April 2011).

[14] UNEP and BNEF, *Global Trends in Renewable Energy Investment 2011* (Paris, 2011).

Figure 5
Top countries in clean energy investment
(Billions of United States dollars)



Source: UNEP and BNEF, *Global Trends in Renewable Energy Investment 2011* (Paris, 2011); and The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G20 Investment Powering Forward* (Philadelphia, Pennsylvania, 2011).

29. During the global crisis of 2008 and 2009, members of the Group of Twenty established stimulus funds of over $194 billion, which had long-term strategic significance for green growth and the clean energy sector. Table 4 presents the status of these funds at the end of 2010. About 49 per cent of the stimulus funds have been spent, with $74.5 billion spent in 2010. An amount of almost $100 billion is expected to be spent in the next few years.

30. A new report commissioned by WWF (World Wide Fund for Nature/World Wildlife Fund) and released in May 2011 ranks countries according to their share of gross domestic product derived from green energy technologies. Based on the national revenue from renewable energy and energy efficiency technologies, Denmark ranks first, with 3.1 per cent of gross domestic product derived from green technologies; China is second, with 1.4 per cent, followed by Germany, Brazil and Lithuania. China has the largest revenue, amounting to $64 billion.[15]

[15] The Associated Press, "Denmark tops list of clean technology producers", 8 May 2011.

Table 4
Clean energy stimulus funds, end-2010
(Billions of United States dollars)

Country	*Total announced*	*Total spent*	*Total remaining*	*Percentage spent*
United States	65	23.2	41.8	36
China	46.1	31.9	14.2	69
Republic of Korea	32.1	11.8	20.4	37
Germany	15.2	8.9	6.3	59
Rest of European Union	11.1	4.2	6.9	38
Japan	10.4	8.9	1.5	86
Australia	3.7	1.6	2.1	44
United Kingdom	3.4	1.1	2.3	34
Brazil	2.5	0.2	2.3	7
France	2.1	2.1	0	100
Spain	1.7	0.6	1.1	36
Canada	0.8	0.13	0.67	17
Total	**194.3**	**94.8**	**99.5**	**49**

Source: UNEP and BNEF, *Global Trends in Renewable Energy Investment 2011* (Paris, 2011); and The Pew Charitable Trusts, *Who's Winning the Clean Energy Race? 2010 Edition: G20 Investment Powering Forward* (Philadelphia, Pennsylvania, 2011).

Renewable energy scenarios

31. A variety of long-term energy scenarios developed by a number of institutions provide projections for renewable energy in primary energy, final energy, electricity generation and electric generating capacity. The estimates vary greatly, from its share in primary energy remaining at the present level (around 13 per cent) until 2035, to rising to 95 per cent by 2050.

32. In *World Energy Outlook 2010*, IEA considers three scenarios: current policies, new policies, and 450 parts per million. These scenarios project that, by 2035, the share of renewable energy in primary energy will range from 15 to 26 per cent, in final energy from 23 to 34 per cent, in electricity generation from to 23 to 46 per cent, and in electricity generating capacity from 31 to 54 per cent.

33. In its 2011 special report,[16] the Intergovernmental Panel on Climate Change indicates a significant increase in the deployment of renewable energy by 2030, 2050 and beyond in most of the scenarios reviewed. A contribution of the renewable energy share in excess of 17 per cent in primary energy supply by 2030 and more than 27 per cent by 2050 is projected. The scenario with the highest share of renewable energy in total primary energy projects an increase of 43 per cent by 2030 and 77 per cent by 2050. The Panel estimates that global cumulative renewable energy investments will range from $1.36 billion to $5.1 billion up to 2020, and from $1.5 billion to $7.2 billion for the decade 2021-2030.

[16] "Special report on renewable energy sources and climate change mitigation".

34. A study by WWF in 2011 concluded that the world can meet its energy demand by 2050 with a 95 per cent share of renewable energy but that, although technically feasible, this would face difficult challenges. The scenario assumes significant improved energy efficiency and expanded electrification as key to achieving this goal.[17] A 2011 report by PricewaterhouseCoopers (PwC), the Potsdam Institute and the International Institute for Applied Systems Analysis[18] evaluates progress in moving towards 100 per cent renewable electricity in Europe and North Africa by 2050. In one scenario, IEA projects that 75 per cent of world electricity generation will be based on renewable energy.[19]

III. Promotion of new and renewable energy

A. National efforts

35. Countries are using different policies for promoting research, development, demonstration, deployment and commercialization of new and renewable sources of energy, and over 115 now have some type of policy support to promote renewable energy. Most of these efforts are coordinated only at the national level. One example at the regional level is that of the European Union, which has advanced the goal of 20 per cent renewable energy in final energy use by 2020.

36. Policies promoting renewable energy can be classified into (a) regulatory policies, (b) fiscal incentives, (c) public finance mechanisms and (d) climate-led policies. Regulatory policies include feed-in tariffs, quotas or portfolio standards, priority grid access, building mandates and biofuel blending requirements. Fiscal incentives refer to tax policies and direct government payments, such as rebates and grants. Public finance includes mechanisms such as loans and guarantees. Climate-led efforts include carbon pricing mechanisms, cap and trade and emission targets.[20]

37. Many countries have adopted a menu of policy incentives instead of a single policy approach. Policymakers realize that incentives need to be coherent, stable and designed for the long term in order to attract the necessary funds for robust deployment and the strong markets that will ultimately reduce the cost of renewable energy.

38. The types of policy incentive vary by country, region and the type of renewable source of energy that countries are promoting. Feed-in tariffs are being widely used in many countries, especially to promote renewable electricity generation.

39. Many of the incentive policies are associated with national targets which, by 2010, had been announced in almost 100 countries. Targets are being defined in terms of the share of renewable energy in primary energy, final energy, electricity generation and electricity generating capacity. Most targets are established for electricity generation and typically specify a share of between 10 and 30 per cent in total electricity generation within one or two decades. More specific targets are also being defined in terms of various technologies.

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[17] WWF, *The Energy Report: 100% Renewable Energy by 2050* (Washington, D.C., 2011).

[18] *Moving Towards 100% Renewable Electricity in Europe and North Africa* (London, PwC, 2011).

[19] IEA, *Climate and Electricity Annual 2011: Data and Analysis* (Paris, 2011).

[20] "Special report on renewable energy sources and climate change mitigation"; and *Renewables 2011: Global Status Report*.

40. A number of countries have been very successful in the promotion of renewable energy through the use of coherent and stable policies. Germany, with a strong policy of feed-in tariffs supporting investments in wind, solar and biomass, has been able to sustain an accelerated growth in the use of renewable energy. In 2010, there was a sharp increase in the deployment of small-scale solar projects to about 9 gigawatts of new solar capacity.

41. China is leading the world in installed new renewable energy capacity, with an annual five-year growth rate of 106 per cent. A combination of national clean energy policies, including feed-in tariffs for wind and subsidies for rooftop and building-integrated photovoltaic solar, has been very successful. China is also leading in manufacturing, producing almost 50 per cent of all wind turbines and solar module shipments. The Republic of Korea shows one of the highest annual five-year growth rates in capacity (88 per cent). Its stimulus package of $32.2 billion is one of the most generous. Renewable energy is promoted by feed-in tariffs, tax exemptions for dividends and long-term loans for manufacturing facilities.

42. Brazil is using electricity generation subsidies and preferential loans to provide incentives for the use of wind, small hydropower and biomass. Its key renewable energy sectors include ethanol for transport, with a production of 36 billion litres annually and a biomass electricity generating capacity of about 8 gigawatts. India is using different policy instruments to promote renewable energy, including feed-in tariffs for wind and solar, accelerated depreciation for small hydropower and biomass, and preferential tax rates for other renewable energy projects. Its new renewable power capacity now totals 19 gigawatts, based on biomass, small hydropower and solar.

B. International institutional arrangements and efforts

43. Organizations of the United Nations system continue to support the promotion and expansion of new and renewable sources of energy in developing countries. Efforts undertaken during 2009 and 2010 have brought attention and awareness in particular to the important issue of universal energy access, energy efficiency and the promotion of new and renewable sources of energy.

44. The Secretary-General's Advisory Group on Energy and Climate Change, created in 2009, called on the United Nations system and its member States to commit themselves to two complementary goals: to ensure universal access to modern energy services and to reduce global energy intensity by 40 per cent by 2030.[21]

45. UN-Energy, the inter-agency mechanism of the United Nations system, continues to promote system-wide collaboration in the area of energy, together with a coherent and consistent approach. It is playing a pivotal role in promoting action and awareness of the importance of energy for sustainable development and is following up the work initiated by the Advisory Group on Energy and Climate Change. UN-Energy has been instrumental in defining three major goals whose achievement by 2030 would assist in securing sustainable energy for all, namely: universal access to modern energy services; a 40 per cent reduction in overall global energy intensity; and a 30 per cent increase in the share of renewable energy in

[21] United Nations, *Energy for a Sustainable Future: the Secretary-General's Advisory Group on Energy and Climate Change — Summary Report and Recommendations* (New York, April 2010).

primary energy. UN-Energy is also promoting relevant activities in support of the International Year of Sustainable Energy for All, 2012.

46. The United Nations Conference on Sustainable Development, to be held in June 2012, will provide an opportunity to assess the progress made in the development and utilization of new and renewable sources of energy. The Conference has two major themes: the green economy in the context of sustainable development and poverty eradication; and the institutional framework for sustainable development. The role that renewable energy technologies will play in sustainable development and poverty eradication, as well as the major challenges and barriers still faced by many developing countries in the effective adoption of these technologies, will be an important part of the debate. Furthermore, the Conference will present an opportunity to establish global strategies for: (a) expanding access to clean energy; (b) enhancing energy efficiency; and (c) accelerating worldwide deployment of renewable energy technologies.

International finance institutions

47. International financial institutions continue to play an important role in mobilizing resources for the promotion of new and renewable energy. The World Bank Group provided loans for the energy sector totalling $13 billion during 2010. Lending for low-carbon energy projects and programmes reached a record of over $5.5 billion. Since 2003, the World Bank Group has invested about $17 billion in low-carbon projects, of which $14.2 billion have been allocated to renewable energy and energy efficiency. Excluding large hydropower, new renewable energy investment represented $4.9 billion of the total.

48. In 2008, the World Bank established the Climate Investment Funds, which is a collaborative effort among multilateral development banks. As of 2010, contributors had pledged $6.4 billion in new funds. One of the components, the Clean Technology Fund, is designed to finance the scaling up of demonstration, deployment and transfer of clean technologies, including renewable energy technologies. The first group of activities includes concentrated solar power, wind power, bus rapid transit and energy efficiency projects in 13 countries.

49. Regional development banks are also playing a crucial role promoting new and renewable sources of energy. The Inter-American Development Bank is planning to double its lending capacity for clean energy to $3 billion annually by 2012. The African Development Bank has made rural electrification a major priority, along with renewable energy development and multinational grid interconnections. Clean energy has become one of the highest priorities of the Asian Development Bank, with over 25 per cent of total loans approved supporting projects with clean energy components. The energy policy of the Asian Development Bank has a target of annual lending for energy projects of $2 billion by 2013.

50. Since 1991, the Global Environment Facility (GEF) has provided financing for projects totalling $8.8 billion, with an additional $38.7 billion in co-financing. In 2010, GEF received from 30 donor countries a record finance boost of $4.25 billion for climate change adaptation and mitigation for the next four years. By the end of 2009, GEF had invested $1.1 billion in renewable energy initiatives in almost 100 developing countries and economies in transition, with an additional $8.3 billion in co-financing.

United Nations Framework Convention on Climate Change

51. The parties to the United Nations Framework Convention on Climate Change, through the Expert Group on Technology Transfer, have been analysing the gaps in and barriers to financing climate change technologies. A number of mechanisms and initiatives to tackle climate change have emerged that support energy technology cooperation and promote financing for new and renewable energy.

52. At its sixteenth session in 2010, the Conference of the Parties to the United Nations Framework Convention on Climate Change decided to establish the Technology Mechanism, consisting of the Technology Executive Committee and the Climate Technology Centre and Network. The Centre is designed to support the transfer of relevant technologies, including renewable energy technologies.

53. Elements of the agreement reached by the Conference of the Parties at its sixteenth session include the provision of $30 billion in fast finance from industrialized countries to support climate action in the developing world up to 2012, and the intention to raise $100 billion by 2020. In addition, the Conference established the Green Climate Fund.

54. The clean development mechanism under the Kyoto Protocol is designed to promote the transfer of clean energy technology to developing countries. It is expected that, in 2012, about 61 per cent of the total number of clean development mechanism projects will be renewable energy projects. At its sixteenth session, the Conference of the Parties decided to strengthen the clean development mechanism in order to drive major investments and technology into environmentally sound and sustainable emission projects in the developing world.

Other institutional arrangements

55. An important international institution promoting renewable energy is the International Renewable Energy Agency (IRENA), established in 2009. To date, 148 States and the European Union have signed the statute of the Agency, the mandate of which is to promote the widespread and increased adoption and sustainable use of all forms of renewable energy. IRENA will facilitate access to all relevant renewable energy information, including technical, economic and renewable resource potential data. It will share experience on best practices and lessons learned regarding policy frameworks, capacity-building projects, available finance mechanisms and renewable energy-related energy efficiency measures. Abu Dhabi has been designated as the interim headquarters for IRENA.

C. Options for coordinated global energy strategies

56. Although considerable progress has been made in regard to the transfer and development of technology, investment and policy implementation, much more effort is needed to increase the contribution of renewable sources of energy and to secure the continuation of the current positive momentum for strong deployment. Additional coordinated strategies are necessary at the global level to advance the transformation of the energy system, especially in the poorest regions of the world, so that the goals of sustainable energy for all, increased energy efficiency and reductions in carbon emissions can be achieved.

Defining strategies and goals

57. There are a number of issues that need to be assessed while defining global energy strategies, goals and targets. To move beyond the international agreed goals on energy, set out in the decisions taken by the World Summit on Sustainable Development and the Commission on Sustainable Development at its ninth session, there is a need to focus on specific actions and targets which could effectively help in the formulation of a more comprehensive road map towards securing sustainable energy for all.

58. The first issue is whether goals need to be defined in terms of primary energy, final energy, electricity generation or electricity generating capacity. This is important because the mechanisms for the promotion of renewable energy depend on the specific form of energy for which the goals or targets have been selected. The choice of policies will depend on whether the main objective is to promote new and renewable sources of energy at the first step of the energy cycle (primary energy) or at the final step (final energy for the main sectors of the economy, e.g. household, industry, transport). Alternatively, since many countries are interested in renewable technologies for electricity, goals may be defined in terms of electricity generation, which would imply specific incentive policies for generation, such as feed-in tariffs, or in terms of electric capacity, which would stress the need for substantial investment for building the infrastructure to ensure the right type of generation.

59. Another issue is whether goals are based on all renewable energy, including traditional biomass. Without the traditional unsustainable biomass, the current renewable share in primary energy is only 7 per cent. Also, if new renewable energy is defined as excluding large hydropower, then its share of 19 per cent in global electricity generation and of 27 per cent in electricity generating capacity (see table 2) drops to only 4.6 per cent and 8 per cent, respectively. Such a decision would allow establishment of the most relevant points of departure in the process towards achieving a particular goal or target.

60. Probably the most important issue is whether goals should be defined separately for developed and developing countries. A close look at these two groups indicates that their circumstances, motivations and objectives are sufficiently different as to justify separate goals. Table 5 summarizes the difference between OECD member countries and non-member countries in terms of total population, population using traditional biomass, population without electricity and per capita use of electricity.

Table 5
Population and per capita electricity use, 2008

	World	*OECD members*	*OECD non-members*
Total population (billions)	**6.7**	**1.2**	**5.5**
Population using traditional biomass (billions)	2.7	~0	2.7
Population without electricity (billions)	1.4	~0	1.4
Per capita electricity use (kilowatt hours)	3 000	8 900	1 700

Source: IEA, World Energy Outlook 2010 (Paris, 2010).

61. Members of OECD, with 18 per cent of the world's population (1.2 billion), consume 53 per cent of global electricity and 44 per cent of primary energy. The annual per capita consumption of electricity is about 8,900 kilowatt hours, or over five times the average for non-member countries (1,700 kilowatt hours). Energy access is not an issue since these countries do not use traditional biomass and are fully electrified. Future scenarios for energy demand in OECD member countries project that the growth will be relatively low compared to the growth in developing countries. Therefore, the main motivations for increasing the use of new and renewable sources of energy are energy supply diversification and environmental concerns, especially in relation to climate change. Another concern for the developed countries is their chance to become leaders in the clean energy sector that would fuel their future green economies.

62. For developed countries then, the goals are mainly of substitution (instead of addition) of renewable energy for fossil fuel capacities and programmes for improved energy efficiency. Most developed countries already have advanced programmes with ambitious goals and targets and count on strong financial support to continue moving towards green economies and sustainable development. For these countries, a coordinated global effort would add support to the already ongoing transformation of their energy systems.

63. Non-members of OECD, which represent 82 per cent of the world's population (5.5 billion), use 47 per cent of global electricity and 56 per cent of primary energy. For these countries, the issue of energy access is indeed critical, with almost 50 per cent of their populations depending on traditional biomass and 25 per cent with no access to electricity. Over 83 per cent of the population with no access to modern energy services lives in rural communities. For developing countries, a global coordinated effort would be key to supporting sustainable development goals.

64. Therefore, in most developing countries the main motivations are to guarantee access to modern energy services for large segments of their population, especially those living in rural areas, and to satisfy the expected dramatic growth in energy demand. For developing countries, new additions of renewable energy capacity are of major priority. For the segment of the population in non-OECD countries with energy access, substitution and efficiency are, as in OECD countries, also important priorities, as is additional capacity to satisfy major increases in energy demand.

65. Using primary energy as the basis for a target is a meaningful approach for assessing the progress made in achieving the main goal of moving 2.7 billion people from using traditional biomass to sustainable modern forms of renewable energy. In terms of shares, of the 18 per cent share of renewable energy in primary energy of non-OECD countries in 2008, only 7 per cent related to non-traditional biomass. An initial target could be to at least replace traditional biomass in order to achieve a truly sustainable renewable energy share of 18 per cent. In terms of electricity generation, an initial goal could be to provide renewable electricity to the 1.4 billion people currently without access. Decentralized electric systems seem to be most appropriate for the 85 per cent who live in rural areas without electricity.

A coordinated global energy strategy

66. A coordinated global energy strategy could be designed to benefit developing countries and, in particular, the population that still uses traditional biomass and has no access to electricity. The strategy should take into consideration three major

factors: (a) about 85 per cent of the people with no access to modern energy services live in rural areas; (b) most rural areas are isolated and require decentralized systems; and (c) almost all rural off-grid renewable energy technologies are still too expensive, even though they are recognized as the most sustainable options for many developing regions.

67. This global strategy would support the specific goals defined by UN-Energy in relation to securing universal access to modern energy services by 2030 while at the same time promoting the use of new and renewable sources of energy. Specific goals would be the replacement of traditional unsustainable biomass by advanced biomass and biogas systems and full electrification with new and renewable sources of energy.

68. The strategy could include four major objectives: (a) development of systems and products specifically designed to address the needs of the poorest segment of the population; (b) reduction of the cost of rural off-grid technologies to levels that could compete with conventional energy options; (c) implementation of innovative mechanisms that would further lower costs to meet the income levels of the target population; and (d) provision of support for capacity-building and technical cooperation programmes that would allow the creation of stable markets for new and renewable energy in developing regions, in particular in rural areas.

69. Almost all rural off-grid technology options, including micro hydropower, biogas gasifiers, household wind turbine, village-scale mini-grid and solar home systems, are too expensive. A major reduction in the cost of these decentralized systems would be necessary if the coordinated global energy effort is to be effective.

70. Specific inexpensive products and systems for households, local industries and services need to be designed, developed and customized for markets in developing regions and for the communities with the lowest incomes. The systems and products need to be reliable and affordable, respond to specific needs and practical applications and be in accordance with local traditions and lifestyles.

71. Cost reductions need to be realized for both the capital cost necessary to acquire and install the systems, and for their corresponding operating and maintenance costs. Three mechanisms are envisioned to support the cost reduction goals: (a) a coordinated effort by international research and development institutions to provide innovations that can make the systems more efficient, practical and cheaper; (b) international and national programmes in the form of technology funds and subsidies to lower the capital cost of the systems, thereby ensuring their affordability at the lowest income levels; and (c) policies in the form of regulations, fiscal incentives and public finance mechanisms that will allow affordable operating and maintenance costs.

72. Research and development activities specifically designed to reduce the cost of rural off-grid technologies can be performed in regional or national technology centres that can be established in developing regions. These centres could benefit from local and endogenous knowledge, as well as advances in technology innovation directed at increasing efficiency and reducing costs, and would provide support in all phases of the innovation process from system development to full market deployment. Such dedicated centres would serve as regional innovation hubs which would develop renewable energy systems shaped by regional and local needs and rooted in a local context.

73. Furthermore, financial instruments, such as microfinance initiatives, and other innovative mechanisms will be necessary at the national level so that these technologies remain below a cost threshold and can be afforded by the people with the lowest incomes. These mechanisms, supported by an international global strategy, will allow the development of stable and coherent markets for these technologies over the long term.

74. The cost to consumers of such a global initiative should be based on energy poverty indicators related to the share of income used for fuels and electricity. Although there is as yet no consensus on such indicators, a household energy affordability limit of no more than 10 per cent of income could be considered.[22] Assuming that populations at the lowest income levels have an average daily income of no more than $2, this would correspond to 20 cents per day. Assuming also that a person needs at least 3 or 4 kilowatt hours of energy a day,[23] the highest cost that can be afforded by the target population would be about five or six cents per kilowatt hour of energy equivalent. A coordinated global initiative would need to be designed to cover the cost above the maximum affordable threshold.

75. The global coordinated effort would also need to address the fundamental requirements for statistical data and indicators which are still not available in many developing countries. Substantial financial resources, capacity-building and institutional changes are necessary to build statistical programmes that would permit the monitoring of progress and the development of integrated energy planning strategies for the long term.

V. Conclusions

76. The accelerated deployment of renewable technologies over the past five years indicates their potential for playing a significant role in the future. Record investments are being made by countries to propel innovation, development and commercialization of these technologies. Furthermore, some countries are competing for leadership positions in markets for the technologies perceived to be the ones that will power the green economies of the future.

77. Nevertheless, the contribution of new and renewable sources of energy to the global energy system is still very limited. For many developing countries, the lack of access to modern energy services and low-carbon technologies represents one of the most important factors affecting achievement of their sustainable development goals.

78. The boom in the growth of the renewable energy industry has not been balanced. Most of the growth is taking place in developed countries and in some developing countries with large emerging economies. Many poor countries with large rural populations have seen only relatively low growth in the use and commercialization of renewable energy technologies.

79. New renewable sources of energy, such as onshore wind, geothermal, small hydropower and biomass, are now becoming competitive in some world regions.

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[22] See, for example, Jill Insley, "Fuel poverty figures are understated, says consumer body", *The Guardian*, 14 July 2011; and United Kingdom, Department of Energy and Climate Change, *Fuel Poverty Methodology Handbook* (London, October 2010).

[23] *Energy for a Sustainable Future: the Secretary-General's Advisory Group on Energy and Climate Change*.

Others, such as solar photovoltaic and concentrated solar power, remain too expensive but their costs are dropping rapidly. Unfortunately, the costs for most rural off-grid renewable energy, including solar home systems and village-scale mini-grids, have remained high.

80. Although countries have adopted major austerity programmes, coherent and stable national policies supporting renewable energy should stay in place, be expanded to other countries and be extended for a considerable number of years. Market mechanisms are necessary to ensure: (a) a further reduction in the cost of technologies; (b) establishment of secure and stable markets; and (c) progress in the transformation of the global energy system into low-carbon economies.

81. The main motivation for a strong deployment of new and renewable sources of energy in most developing countries is to guarantee to everyone access to modern energy services and to satisfy expected rapid increases in demand. Access is seen as indispensable for accelerating the movement towards green economies within the context of poverty eradication and sustainable development. Cheap and decentralized systems are major incentives for developing countries, since their rural populations are the most affected. Other major concerns for both developing and developed countries are diversification of energy supplies and reduction of climate change impacts.

82. Challenging but achievable goals and specific but meaningful targets can contribute to the promotion of new and renewable sources of energy. Given the differences in factors affecting the energy systems of developing and developed countries, separate but coordinated energy strategies may be more effective. According to the specific goals, targets may be defined in terms of shares in primary energy, final energy, electricity generation and electricity generating capacity. Furthermore, how the targets are defined will allow determination of the most effective incentive mechanisms for the promotion of new and renewable sources of energy.

83. A coordinated global energy strategy is necessary, especially to support developing countries and in particular the poorest among them. Efforts should concentrate on solutions for rural areas most affected by the use of traditional biomass and by lack of electricity. Support at the international level is necessary to help remove the financial, technological, infrastructural and institutional barriers to creating the enabling environments.

84. Reduction of the high cost of decentralized systems for rural applications should be a key part of any major coordinated global energy strategy. Specific targets and programmes are required to enable the environment that would secure sustainable energy for the rural populations of the world.

85. There is a need to establish regional and national technology centres both to develop systems and products specifically designed to address local needs at appropriate levels of income and to benefit from endogenous capacities and local knowledge. The global strategy needs to include a strong component on statistical data and the development of integrated programmes for long-term energy planning.

86. International institutional arrangements, including the various organizations of the United Nations system, international financial institutions and international organizations, such as IRENA, continue to play an important role in promoting international cooperation through capacity-building and technical cooperation.

UN-Energy is leading global efforts to create awareness and is coordinating activities undertaken by the United Nations to secure sustainable energy for all, increase the share of renewable energy and reduce the intensity of energy use.

87. New and renewable sources of energy represent a major priority issue for the United Nations Conference on Sustainable Development in 2012. Strengthening the global institutional framework for the promotion of new and renewable sources of energy in line with the two themes of the Conference is an important objective. The Conference presents an opportunity to secure renewed international support for the promotion and effective use of new and renewable sources of energy.